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Vol. 6 MARCH, 1925 No. 3

## CONTENTS

EDITORIALS ..... 51
—"A. E." Also Means Agricultural Efficiency
—Why not an Engineered Household

PROPER INSTALLATION FOR WARM AIR HEATING ..... 52
By E. A. Stewart

DEMONSTRATION OF AN ELECTRIC FARM ..... 57
By R. U. Blaisingame and E. G. Lantz

AN OUTSTANDING ENGINEERING SERVICE ..... 58
By Herbert Hoover

OPERATING AN IOWA FARM WITHOUT HORSES ..... 59
By Roy E. Murphy

RESEARCH IN AGRICULTURAL ENGINEERING ..... 61
—Soil Colloids and Tillage
By R. W. Trullinger

AGRICULTURAL ENGINEERING DIGEST ..... 64

NEWS SECTION ..... 65

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## The Object and Scope of A. S. A. E. Activities

THE American Society of Agricultural Engineers was organized in December, 1907, at the University of Wisconsin by a group of instructors in agricultural engineering from several state agricultural colleges, who felt the need of an organization for the exchange of ideas and otherwise to promote the advancement of agricultural engineering. The object of the Society, as defined by the Constitution, is "to promote the art and science of engineering as applied to agriculture, the principal means of which shall be the holding of meetings for the presentation and discussion of professional papers and social intercourse, and the general dissemination of information by the publication and distribution of its papers, discussions, etc."

The membership of the Society represents all phases of agricultural engineering, including the educational, professional, industrial, and commercial fields.

The scope of the Society's activities embraces both the technical and economic phases of the application of engineering to agriculture, and is comprehended in the following general headings:

(a) Farm Power and Operating Equipment—power, implements, machines, and related equipment.
(b) Farm Structures—buildings and other structures and related equipment.
(c) Farm Sanitation—water supply; sewage disposal; lighting, heating, and ventilating of farm buildings, and related equipment.
(d) Land Reclamation—drainage, irrigation, land clearing, etc., and related structures and equipment.
(e) Educational—teaching, extension, and research methods, etc., employed in the agricultural engineering field.

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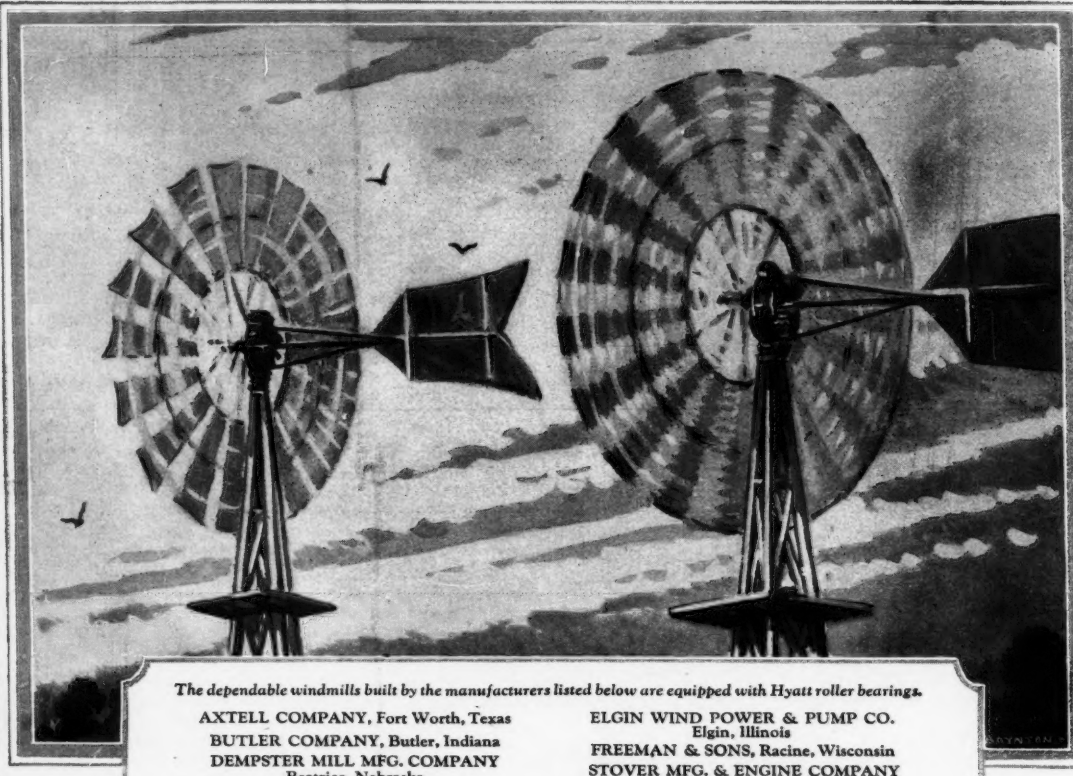

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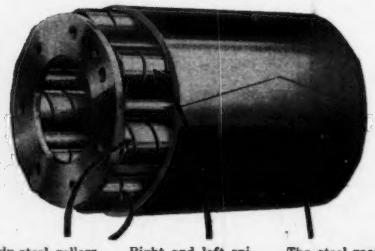

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# AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

RAYMOND OLNEY, Editor

Vol. 6 MARCH, 1925 No. 3


## EDITORIALS

### "A. E." Also Means Agricultural Efficiency

AN old schoolmaster farmer, a neighbor of mine, frequently used this expression when addressing the local literary society; "Any fool can make money, but it takes a smart man to keep it." This saying cannot be more fittingly applied to anything than to present day farming, that is to say, anyone can raise crops, but it takes an efficient farmer to show a profit.

Farming has not always been a business; it is such to only a small percentage of farmers today. To our grandfathers, farming meant the clearing or breaking of land for a home, the wherewithal to grow sufficient food for their dependents. To our fathers, farming consisted first in the raising of a mortgage and secondly in the saving of enough money to give the boys a start and to provide for a small "retirement fund".

Two generations ago the only thing to be gained by the use of labor-saving machinery was convenience and a lessening of hard work; any time which was saved outside of harvest time was of little value because it could not be sold. Farm machinery got a foothold because of its labor-saving features and through the fact that harvesting and other work, which had to be done within a narrow time limit, could be speeded up by its use.

Today all this is changed. We use machinery because we can sell all spare man-hours at a good price on the industrial labor market.

Too many of us are, however, not even conscious of the newer forces at work in our industry of agriculture. We still farm as our fathers taught us to do. We buy machinery not as an investment from which we may expect returns, but as a source of convenience and comfort, as our fathers did. We have not learned to think in terms of cost of production.

It is the work of the agricultural engineer to carry into our country communities the vision of a more and more efficient agriculture. The message which will make our farmers consider farming as a business instead of an occupation and which will make science instead of custom govern our farming methods, must be carried by the agricultural engineer. Much money has been spent by our governments to place before the farmer the priceless findings of our specialists in animal and cereal husbandry and in other branches of agriculture. Extension work consisting of "drives" in some particular branch of farming has had find purebred cattle in scrub stables and the latest variety a rather one-sided effect. As a result we very frequently of grain grown on land the plowing of which represented a labor cost of about $4.50 per acre.

The engineer's work in agriculture is inseparably wrapped up with efficiency in agricultural production. Is not this the fundamental reason for our existence? In Canada and in some sections of the United States the extension field in agricultural engineering has not been touched. It seems absorb all the real agricultural engineering energy our to me that here lies the job which, when developed, will colleges can turn out. "A. E." stands for Agricultural Engineering, but it should also mean Agricultural Efficiency.

L. G. HEIMPEL

### Why Not An Engineered Household?

ED HOWE says it used to be no uncommon thing to find a man hale and hearty with his third wife, the first two worn out by the heavy toil of frontier life.

Fifty years have brought wonderful developments to the American farmer. He now has the binder, combine, corn picker, gasoline engine, tractor, and many other items of farm equipment to reduce his labor.

At the same time the census figures show that only about ten women in every hundred have the most essential convenience of running water in the home. The other ninety are carrying water and doing the same heavy tasks about the farm with very little more assistance in the way of labor-saving equipment than they had 50 years ago.

I recently noted one instance of a farm in northwest Arkansas which was settled seventy years ago. Since that time the farm has provided a living for some three generations of farmers . At one time it was reputed to have the best apple orchard in this section of the state. Today a tractor is a part of the regular equipment and terraces conserve the fertility of the soil; but for sixty-nine of these seventy years the women have carried water more than one hundred feet up a steep rocky slope to the house. As a conservative estimate, they have carried more than 3000 tons of water in those years. It is only within the last year that a seventy-dollar hydraulic ram outfit was installed, which lightens the farm wife's labor by raising 300 gallons of water to the house every twenty-four hours.

Although tractors are being brought into Arkansas at the rate of one hundred and thirty every month, extension workers have been able to interest only five per month in the installation of water in the home. Including both commercial and home-built water systems, it is doubtful if there is anywhere near one-third as many water systems being installed as there are tractors being placed on the farms. According to Missouri studies, the work day of the farm woman is 16 hours long, 12 of which are taken up with household duties. She is on a wash-tub—kerosene—water-by-the-pailful standard. Her husband goes by the slogan "Good equipment makes a good farmer better". We have an engineered agriculture, but we do not have an engineered household.

Just as the agricultural engineer is so largely responsible for the rapid mechanical development in agricultural lines, so he must, in the future, be largely responsible for development that will put labor-saving equipment into every farm home. It is not necessary to let down on our activities along any line of agricultural work. Some valuable work has already been done on household engineering, but it is a fact that much more will have to be done in the future that has been done in the past. It means that agricultural engineers must accept as their own problems, those features of home equipment which save time and labor by mechanical means.

DEANE G. CARTER

### A Correction

THIS notice is to call attention to an error in the February issue of AGRICULTURAL ENGINEERING, in which the article "Major Problems in a Study of the Irrigation of Rice by Pumping," by Deane G. Carter, was credited to R. W. Trullinger on the front cover and in the contents of that issue. The proper credit was given at the beginning of the article itself, and we trust there was no serious confusion in the minds of Journal readers.

# Proper Installation for Warm Air Heating *

By E. A. Stewart

Mem. A. S. A. E. Division of Agricultural Engineering, University of Minnesota

I AM giving this paper not because I believe that warm-air heating needs to be defended by the engineer but because it offers a chance to give some important phases of the installation. You will note that my title is qualified by the clause "when properly installed." This qualification is added because the type of installation largely controls the desirable features of warm-air heating. Do not assume, however, that we feel we know how they should be installed; we know only insofar as tests have shown.

I wish to point out some of the disadvantages of poor furnaces and poor installations before I take up the merits of warm-air heating, as the disadvantages when present are so basic that they overshadow the advantages. The two most oustanding disadvantages and the two things which have kept warm-air heat out of tens of thousands of homes are dust and gas coming up with the heated air and the inability to heat some rooms in the house. The first is by far the worst offender.

Thousands of homes that have been built in Minnesota and the northwest in the last ten years today would have warm-air heat instead of hot-water heat had it not been for the dirt and dust that was carried through the warm-air ducts in the poor, cheap types of furnaces installed fifteen and twenty years ago. Thousands of such cheap furnaces are being installed in farm homes at the present time. Many of these are very unsatisfactory and well-to-do farmers are now demanding hot-water heat. This is a shame because the warm-air heating systems offer several advantages to a farm home owner that he cannot secure in a hot water heating system. The quickness with which a warm-air plant heats up and the non-freezing troubles are sufficient reasons for a farmer to justify his use of a warm-air furnace, but the cheap furnace that leaks gas or dust in one or two years is a curse. It is a menace to the man who manufactures it, to the man who installs it, and to the thousands of home owners who might be better off financially and might enjoy better health, happiness and more comfort, if they had a properly built heating plant.

The second disadvantage, the inability to heat some rooms properly, is neither as fundamental nor as serious. Proper installation will take care of this trouble. It is necessary, however, for all of us to be awake to the situation in order to secure proper installation. After discuss- that make a fine warm-air heating system.

There are thirteen distinct advantages to which a warming the bad features we will now take up those features air heating system can lay claim. They are named in the order of their importance as they affect home owners:

1. The temperature in the house may be raised to the proper condition very quickly in the morning or at other times when the temperature in the house is lower than it is desired.

2. The heating plant may be used very effectively and efficiently to warm the house for a few hours in the morning during fall and spring weather.

3. The proper humidification of the air can be carried out more effectively, more easily, and with less expense with a warm-air heating system.

4. The circulation of air from one room to another is more effective and makes possible the use of the air leakage in all rooms to supply outdoor air to the occupied rooms, thus eliminating the necessity of open windows in occupied rooms with their attendant loss of heat and moisture.

5. The room temperatures can be kept at a more constant value than it is possible to do with other types of heating.

6. The heating plant will not streak and dirty up the walls and curtains like radiators do, if the proper type of register box is used. Installers should be discouraged in the use of homemade contraptions that they say are "just as good" but in reality are a serious drawback on the future of furnace heating.

7. All rooms in the house can be heated properly just as well as with hot water or steam and the flexibility of the system by damper control makes it possible to heat some particular room more quickly or heat it to a higher temperature than the other rooms.

8. The flexibility of the system makes it possible to hold room temperature at nearer the proper amount under adverse wind conditions than is possible with other types.

9. The temperature difference between floor and head level can be kept as low as that secured in hot-water heating with proper installation; in other words, cold floors are not a necessary concomitant thing with warm-air heating.

10. The warm-air heating equipment in the room does not utilize valuable space, nor does it increase the amount

*Paper presented at the 17th annual meeting of the American Society of Agricultural Engineers, Chicago, November 1923.

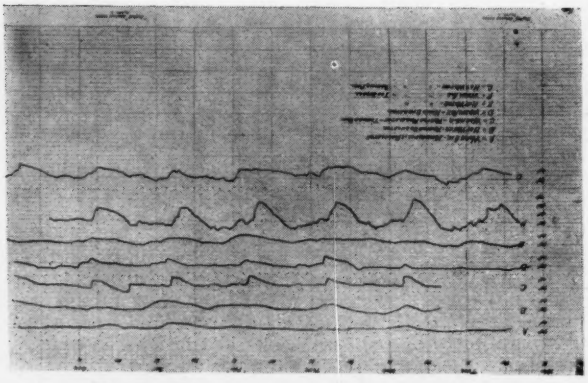


Fig. 1. Temperature records in seven houses

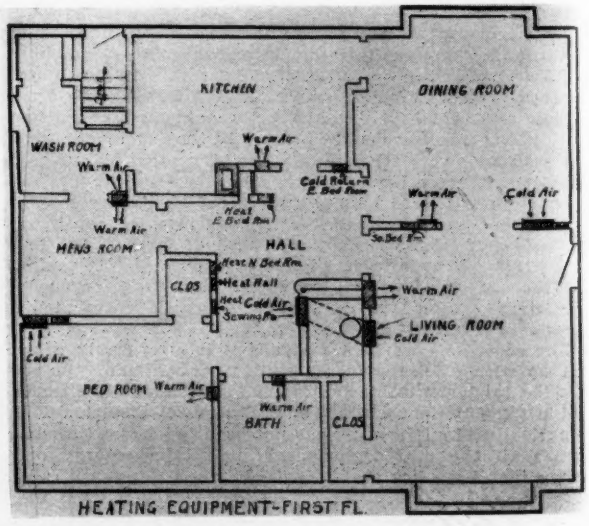



Fig. 2. Cold air registers in all the main rooms

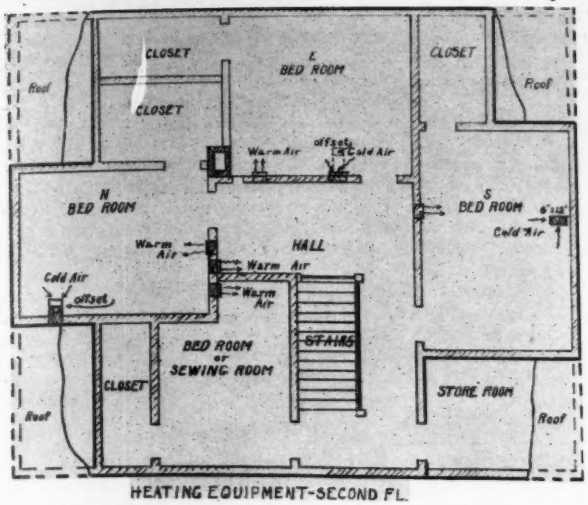



Fig. 3. Return air from bedrooms assists ventilation

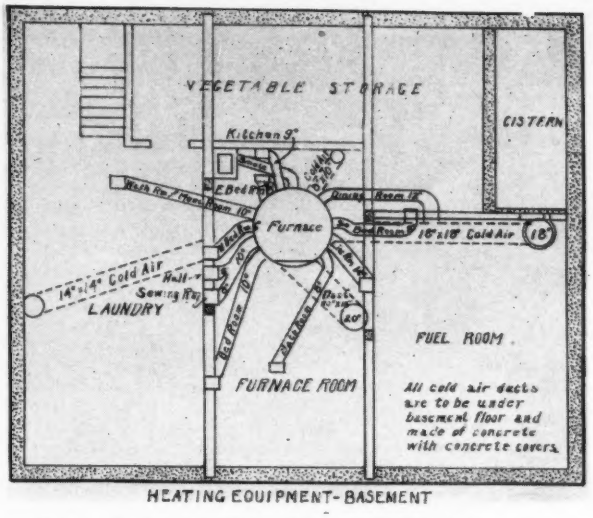



Fig. 4. In this installation the furnace is centrally located

of work required in house cleaning that the radiator does.

11. The flexibility of the heating plant makes it possible for the operator to use less fuel, if he wishes to be conservative, during a heating season than with other types and yet maintain comfortable conditions, when and where they are needed.

12. The equipment need not unnecessarily clutter up the basement any more than other types of heating plants.

13. The cost per year during the lifetime of the plant is undoubtedly somewhat below the cost of other types of heating equipment excepting that of stoves.

Following is a discussion of these advantages, at the same time giving you proof on which the statements are based.

The temperature in the house can be raised very quickly in comparison with that by hot water or steam heating. Very frequently someone will claim that his hot water plant will heat the house very quickly in the morning. I have taken scores of records and I fail to substantiate their claims. The cause is inherent in the type of plant. For instance, in a house of 10,000 cubic feet capacity, that has 600 square feet of hot water radiation, we can show why it must heat up slowly. The weight of iron in the pipes and radiators would be about 3,600 pounds. This is equivalent to about 400 pounds of water as far as heating is concerned. The heating system contains about 1000 pounds of water. The water and iron must be heated through about six times the range in temperature that the air is and this makes the water equivalent of these two six times as great as given above. The air in the building weighs about 830 pounds and is equivalent approximately to 200 pounds of water as far as heating is concerned. The weight of iron in the furnace and in the boiler will about equal each other for our discussion. We shall assume in both cases that we must heat about 10,000 pounds of building material which is equivalent to about 3000 pounds of water. This means then that in warm-air heating we have a job equivalent to heating 3,200 pounds of water while in hot water heating the job is equivalent to heating 11,600 pounds of water, or nearly four times as much heat is required to bring the rooms up to the proper temperature.

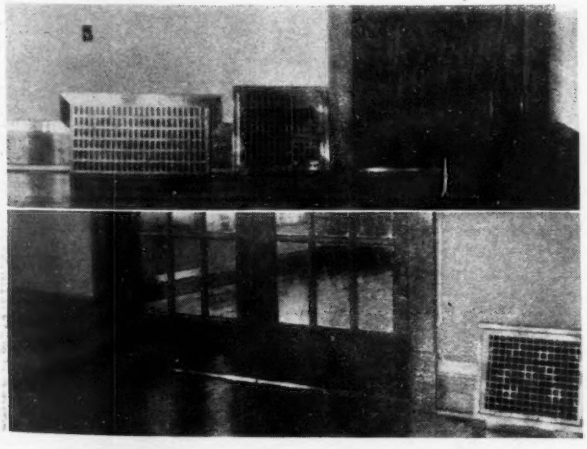


Fig. 5. (top) Fig. 6. (bottom). Shows two different arrangements of cold and warm air registers

The most rapid rise in temperature that I have ever secured in a hot water heated house was 10 degrees in one hour and ten minutes, but the damper in the chimney pipe was red hot for three-fourths of this time. This is not a practical operating condition. Even our hot-water friends will agree that 10 degrees Fahrenheit rise in room temperature in two hours is considered standard practice. In fact, if the temperature is made to rise faster than this the room will get too hot before the water cools down again. In reality it usually takes three or four hours for a 10 degree rise in room temperature with hot water heating, while I have found warm air plants that would raise the room temperature 10 degrees in thirty minutes.

Records showing what can be done in raising the temperature in a house in the morning were taken in a warm-air heated house and in a house heated with hot water. Both heating plants were controlled by regulators. The record for the warm-air heated house shows that the temperature was raised eight or ten degrees in about one-half hour each morning, while the other shows that considerable time was required to bring the temperature up to 70 degrees when it was only down to 63. The records show also that the temperature in a hot water heated house is very likely to go up to a higher temperature than desired, while that in a warm air heated house is readily controlled. This shows why hot water is not practicable for supplying heat for chilly mornings in the fall and spring.

The air in most of our homes is too dry. The warm-air furnaces are now being equipped with water pans that give fairly good service in humidifying the air. The older types of water pans do not evaporate as much water in a week as they should do in one day. This is also the fault of most devices or humidifying pans that are used with warm water and steam heating plants. There are a few makes of water pans that can be used with hot-water systems and will evaporate the proper amount of water. It is necessary, however, to cover all radiators with these pans and then a new problem is presented for solution. The time and trouble of keeping all of these filled with water is more than the average householder will care to take. The result is that the pans are not used.

The amount of water required for humidification is not as great as is generally assumed. Our records shows that five to eight gallons of water per day will produce good humidity conditions in houses with double windows, and you cannot use good humidity in houses with single windows during cold weather.

The air leakage in bedrooms can be utilized to supply so-called "fresh air" to the other rooms in the house, if the heating system is provided with the proper cold-air ducts. A plan of a heating installation that does this will be shown herewith. In one house I will give some records to show the amount of ventilation secured through air leakage in bedrooms. The total amount of air return from two bedrooms when the warm air was not turned on was 51 cubic feet per minute, while from the living room and dining room it was 38 cubic feet per minute.

In another case, when the heat was turned on in all the rooms, but the bedrooms were at a colder temperature than the living room, the total amount of air returned from four bedrooms was 173 cubic feet per minute compared to 214 cubic feet per minute from the rest of the house. The lower temperature in bedrooms contributed quite largely to the amount of air taken from them. In a bedroom that was 8 degrees cooler than a living room when the cold air from each entered the same cold air shaft with the longer run for the bedroom, the velocities of the return air at the register faces was 65 feet per minute for the bedroom and 25 feet per minute for the living room.

Another illustration will be sufficient. In a church we found that we were taking 1196 cubic feet per minute from the main auditorium when it was cold and no warm air being put in, while we were taking 1210 cubic feet per minute from the basement and putting 2300 cubic feet per minute of warm air into the basement. In other words, we were getting about 1,200 cubic feet of fresh air in leakage upstairs and the same amount of out leakage downstairs. All of these figures show how distribution of air from all rooms aids in ventilation.

Statement number five above reads: "The room temperature can be kept at a more constant value than it is possible to do with other types of heating." This statement is made after scores of temperature records have been taken and these investigations carried on for a number of years.

The graphs shown in Fig. 1 will indicate some of the facts found in this investigation. Someone may object to these being taken as conclusive evidence as they are only single cases. These are representative graphs selected from a number of such records. I have many other records which show the same features.

These graphs were taken during several winters. Part of the records were taken in Kansas and part in Minnesota. I have the records of outdoor temperatures and the characteristics shown in these graphs are not due to outside temperature effects. The records were taken for approximately one week each.

The first record (A), as the chart shows, is a record in a warm-air furnace heated house. This furnace has sufficient capacity. The installation has several faults, but in spite of these, the whole seven rooms (hall and bath in addition) are well heated. The regulator on this system was not changed during the week. The furnace was operated by an eighteen-year-old boy. The dampers were partly closed at night instead of changing the regulator. This graph shows that outside temperatures did not influence the temperature variation much inside. One day during this time the outdoor temperature was up to 61 degrees and one night it was as low as 6 degrees. This was our largest weekly variation in temperature for the winter.

The second record (B) was taken in a well-built eight-room house heated with a hot-water system. The difference in variation in temperature is very noticeable. The temperature remains low in the morning and then rises higher than it should because the regulator cannot prevent it. The two graphs on Saturday show distinctly the difference in response of the two systems after a sudden drop in temperature out-of-doors early Saturday morning.

The third graph (C) shows the fine result that it is possible to secure with a warm-air furnace of good capacity, when well regulated. I have never been able to secure a record from a hot-water heated house where coal is used for fuel which approaches this in uniformity of temperature. The variation in this house from 7:30 A. M. to 10:00 P. M. is usually only two degrees. The ten degrees drop in temperature at night secures some saving in fuel. The large-capacity furnace in the warm-air type enables the owner to secure the proper daytime temperature in from twenty to thirty minutes after the regulator opens the draft. Note also the rise in temperature secured Saturday evening at 8:00 P. M. They wanted the house warmer for bathing the children.

The curve D shows a more uniform daytime temperature than was shown in B, even though this was a hand-operated plant. This man's thermometer was on an inside wall, but near the corner close to an outside wall. He kept the proper temperature as shown on his thermometer, but the radiation to the cold wall allowed it to register about 3 degrees low.

The result shown in curve E of a hand-operated hot-water system is as good a regulation as is secured in B. I find this to be nearly always true when operated intelligently. Low temperature in the forenoons is quite noticeable, however.

Curves F and G are given to show poor hand regulation of warm-air and hot-water systems. The in F is the type of temperature variation that many people think is characteristic of warm-air heating. This is not so. I have never secured a variation in any other house that approaches this in its irregularity. Undoubtedly the warm air gave more fluctuations in temperature than did the hot-water system in G, but the variation from maximum to minimum from 8:00 A. M. to 10:00 P. M. is greater in the hot-water heated house. Another advantage in favor of the warm-air heated house was that the house was warm every morning by 7:30 A. M., even though he shut the furnace almost air tight at

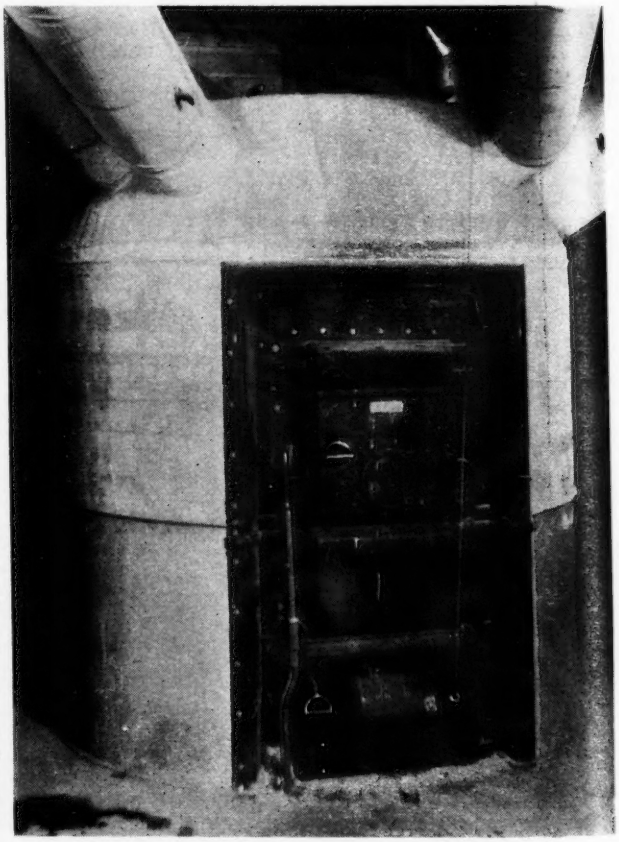


Fig. 7. This furnace is free from shoes for the cold air

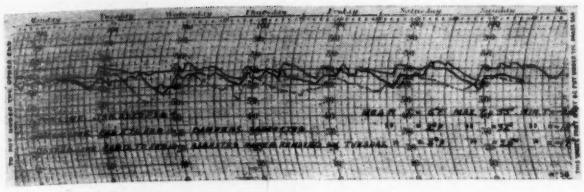


Fig. 8. Basement temperatures can be kept cool

night, thereby saving considerable fuel. This was not true of the hot-water heated house.

The fluctuation in temperature in F in the daytime was caused by poor operation. This man was more than 60 years of age and had never operated a furnace until the last three years. He was around the house most of the time and would open the drafts wide open as soon as the house began to feel cool to him. He used no thermometer. When the house was warm he would close the dampers again.

The man operating the boiler in the house where record G was taken tried to see how fast a rise in temperature could be secured on Friday morning. The outdoor temperature dropped suddenly during the night to 6 degrees above zero, but came up to 22 degrees at noon. The man fired up heavily about 9:30 because opening the draft in the morning had not raised the temperature. The temperature was raised 10 degrees in about one hour and ten minutes. This is the most rapid rise in temperature that I have found to occur in a hot water heated house in cold weather. When the temperature reached 70 degrees he closed the draft. At this time, and for nearly the whole hour preceding, the chimney damper was red hot. Note that the temperature still increased to 74 degrees after closing the draft. This is very characteristic of hot-water heating.

### Regulators on Warm-Air Heating Systems Are Practical and Necessary

These graphs are eloquent testimony to the need of regulators on heating systems. They also show that a regulator is more efficient when applied to warm-air heating than when used on hot-water heating systems. After taking a large number of records, I must say that the statement "put in a hot-water system to secure an even temperature" so frequently used is not true. Warm-air heating under intelligent operation or when automatically regulated will give less variation in temperature.

I have records taken in a house heated with an oil burner under a hot-water boiler, and also in one heated with an oil burner in a warm-air furnace. While fine regulation was secured in the former, the records show that in the latter the temperature did not vary even 1 degree during a whole 24-hour period.

Proper temperatures may be secured in all rooms. The following temperatures were taken in a seven-room house with six cold-air ducts. The temperature out-of-doors was 12 degrees with a wind of 25 miles per hour from the northwest.

**House Temperatures — Head Level**

| | | | |
|---|---|---|---|
| Living room, west, | 71.5° | Bedroom, northwest, | 65° |
| Hall, south, | 67° | Bedroom, south, | 71.5° |
| Dining room, north, | 69° | Bedroom, east | 71.5° |

This shows a very small effect due to the wind. In a hot-water heated house the temperature is affected by wind in a similar way. With a southeast wind of twenty miles per hour the temperature taken in a hot-water heated house was:

| | | | |
|---|---|---|---|
| Living room, east, | 70.5° | Bathroom, west, | 83° |
| Dining room, south, | 72° | Bedroom, northwest, | 77° |
| Kitchen, southwest, | 71° | Hall, north, | 72° |

This same house shows a big variation from these temperatures when the wind is in the west. The temperatures below were taken when the wind was blowing from the west at thirty miles an hour at an out-of-doors temperature of 10 degrees Fahrenheit, which was just the same as the temperature during the time the readings above were taken.

| | | | |
|---|---|---|---|
| Living room, east, | 70° | Bathroom, west | 69° |
| Dining room, south, | 70° | Bedroom, northwest, | 68° |
| Kitchen, southwest, | 71° | Hall, north, | 68° |

You will note the large difference in the bedroom and bathroom temperatures when the living room is kept at about the same temperature, from what these temperatures were when the wind was from the southeast.

It is very important that the heating system be so designed that the house can be heated with warm air instead of hot air. The pipes and register faces must be large and the casings small. The houses that are heated with hot water usually show warmer floors, or less difference in temperature between floor level and head level, than do houses heated with warm air. This is not necessary. The table given below shows three representative sets of readings taken in different houses. All readings were taken late in the morning or afternoon when the house had reached a uniform temperature.

**House Temperatures**

| Warm Air Heat 1 | 2 | 3. | House number | Hot Water Heat 1 | 2 | 3 |
|---|---|---|---|---|---|---|
| 67.5° | 73.5° | 88° | Ceiling temperature | 71° | 69° | 71° |
| 67° | 68° | 73° | Head level temperature | 70° | 67.5° | 68° |
| 63° | 62° | 60° | Floor temperature | 67° | 63° | 63° |
| 4.5° | 11.5° | 28° | Difference—1 | 4° | 6° | 8° |
| 4° | 6° | 13° | Difference—2 | 3° | 4.5° | 5° |

The "Difference — 1" gives the difference in temperature between the ceiling and the floor (about two inches above the floor) while "Difference — 2" gives the differences between head level and floor level temperatures. You will note that house No. 1 under warm-air heat gave as satisfactory a temperature variation as is secured in hot-water heated homes. The house No. 1 in each case is the best record, while that of house No. 3 is a poor record. The reason why there is such a small difference in temperatures in house No. 1 is because the house was heated with a large volume of warm air, while house No. 3 was heated with a small volume of hot air.

The relation between the temperature of the air at the register face and the variation in temperature between the ceiling and floor is very striking. The following table gives some actual temperature records:

| Temperature Register Face | Temperature Difference Ceiling to Floor |
|---|---|
| 198° | 28° |
| 162° | 25° |
| 140° | 20° |
| 125° | 11.5° |
| 94° | 7° |
| 88° | 4.5° |

It appears then that cold floors are not found where the system is properly designed.

The designing of the system means not only the use of properly sized and properly placed ducts, registers, etc., but the size of casings must be considered in relation to free air area in the heating pipes. If large casings are used the air moves slowly, becomes highly heated and is inefficient.

In designing a heating system that will give the advantages mentioned in the first part of this paper, the use of under floor return air ducts will do away with the objection that many people make concerning the pipes in the basement. Cold air returns from all rooms, or nearly all rooms, with the exception of bathrom and kitchen will do away with those so-called "cold rooms" that have lost the warm air heating industry thousands of heating jobs.

The heating plans shown in Figs. 2 and 3 are those for a heating plant which cannot be objected to on account of cold rooms or because the basement is cluttered up with pipes . The cold air returns are taken from all rooms with the exception of the small rooms such as sewing room, men's room, washroom, bathroom, and kitchen. The warm air pipes for these small rooms are always oversize, and if the cold air pipes from adjoining rooms have large capacity then these rooms will not bother about heating properly I have tested a number of plants designed somewhat on these principles and these small rooms heat the best. The

men's room in this house is on the north side, but it is usually one to five degrees warmer than the other rooms. The cause of this is readily explainable.

The basement plan is shown in Fig. 4. The furnace is well located so that all the runs are comparatively short. The first-floor bedroom has one of the longest runs, but it is rather singular that the air at the register face in this room is often higher than in the other rooms. The cold air returns are placed under the basement floor as shown. The galvanized iron circular ducts run from the register boxes straight down and open into the rectangular ducts below. All four cold air ducts meet in a central pit under the furnace. A test of this plant shows that all cold air returns operate very well.

Installations of warm-air heating plants can be made attractive and yet meet with the principles of approved practice. Fig. 5 shows how the cold-air and warm-air registers appear in the living rooms of this home. The cold air is farthest toward the outside wall of the room. It would be better to have these farther apart, but it is not necessary.

### Attractive and Practical Arrangements of Cold-Air and Warm-Air Registers

Fig. 6 shows a very desirable arrangement of cold-air and warm-air registers. This view was taken looking west in the dining room. The cold air register is toward the outside wall. It is sometimes possible to duplicate this arrangement on the living-room side of this wall, but we could not do so in this house.

The space under the stairway in this house is used for a cold air return duct and register. This idea can be employed very frequently when the heating plans are made before the house is built.

It is frequently very desirable to place the kitchen register high up in the wall. The space below is then available for a kitchen cabinet, table, or for some other use. This type of installation can be employed in bedrooms and bathrooms to very good advantage many times.

The basement installation in this house is very interesting. Fig. 7 shows how neat the furnace appears. The high ceiling in the basement gives a good rise to the leader pipes and gets them up out of the way when but a few feet from the furnace. Note that three layers of air-cell asbestos were used for covering the pipes and for lagging on the upper part of the casing. The cold-air return duct from the east bedroom can be seen over the top of the furnace.

We find very frequently that furnace installers are still inclined to use the plain asbestos paper as an (so-called) insulator for the warm-air pipes and for the furnace. They tell me that people want it for the looks of it or because they believe that it is better than nothing.

I do not have any difficulty in keeping it off on jobs that I have anything to do with. Fig. 8 shows one of the finest proofs that it is better to keep asbestos paper off the basement warm-air pipes. The curves on this record also show that poor damper regulation may be the cause of high fuel bills and warm basements. The temperature records for this chart were taken for three successive weeks in the basement of a home. (Our records also were for one week before and also another week after.) The close uniformity of outside temperatures as given on the chart was a lucky accident, all three weeks being very cold weather—below zero every night. The top line record was taken just as we found the furnace installation. The damper control was then corrected and the second solid line shows that we decreased the average basement temperature about five degrees. The third or dotted line is the most interesting. The installer had a man remove the asbestos paper from the warm air pipes on Tuesday of the third week. Note what happened to the basement temperatures when this was removed. In the case of this home the saving in fuel was very marked by these two simple remedies.

### Cold-Air and Warm-Air Registers Placed Close Together

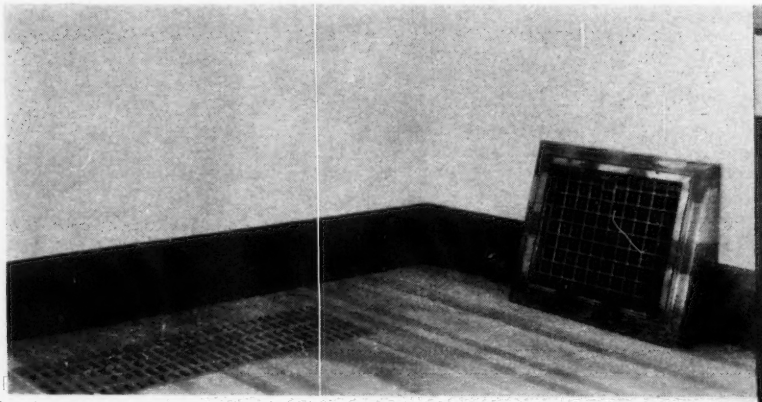
Two more views show how the cold-air and warm-air registers may be placed close together with the cold-air register near the cold outer wall.

Fig. 9 shows how the space under a stairs is utilized for the cold air. This is next to an outside wall and keeps the cold air from the stairs and outside door from spreading out over the floor. The warm air comes out from under a seat. This is very satisfactory to the home owner. This living room is very large and has another warm-air and cold-air register on the other side of the fireplace. A part of the fireplace is shown in the illustration.

Another installation of a cold-air and warm-air register is shown in Fig. 10. The cold-air is placed beneath a window at the end of the living room. This warm-air register is quite close to an outside wall as will be seen in the illustration. The installers were afraid that this warm-air duct (16 feet) was too long to work well. I designed it oversize and placed it on a favorable part of the casing. The test showed that this duct was operating exceedingly well; in fact, we had to damper down the pipe to keep this room cool enough.

With installations of this type we are proving that warm-air heating has all the advantages claimed for it in the first part of this paper.

NOTE: Prof. Stewart showed a great many lantern slides illustrating records and views of installations, but space permits showing only a few here.



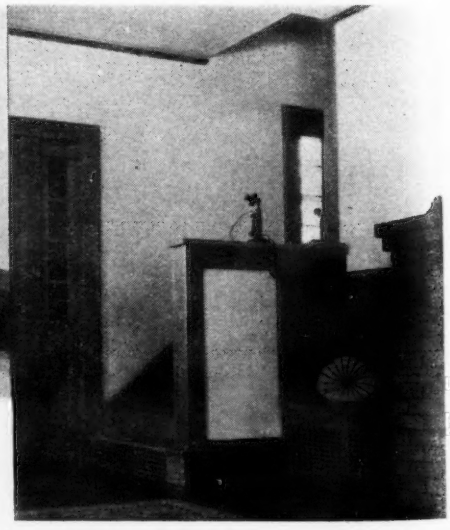


Fig. 9. (left). Note cold air return under the stairway and warm air register under the seat between fireplace and stairway
Fig. 10. (above). This is a good arrangement of cold and warm air registers

# Demonstration of an Electric Farm

By R. U. Blasingame and E. Grant Lantz

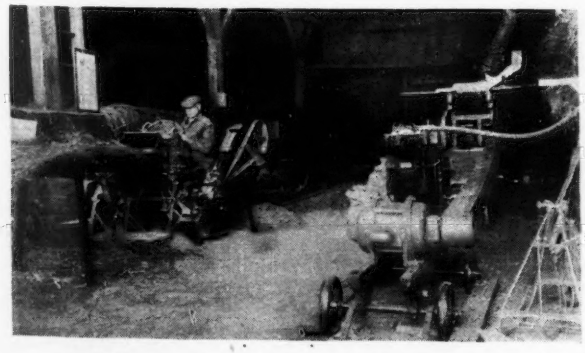
"OUT of a desire to present to the farmers of Pennsylvania the latest achievements of the electrical industry designed to make farming and farm life more satisfactory came the idea of completely electrifying a typical farmstead and having it open for public inspection during the week of the State Farm Products show held at Harrisburg, January 19-23, 1925. The idea was approved at a meeting attended by representatives of the Giant Power Survey, Pennsylvania Department of Agriculture, Pennsylvania State College, Pennsylvania State Grange and the Pennsylvania Electric Association, including manufacturers of electrical equipment. The electric farm committee was then appointed and instructed to proceed with the project. This committee consists of F. P. Willits, chairman, state secretary of agriculture; Judson C. Dickerson, Giant Power Survey; R. U. Blasingame, Pennsylvania State Grange; M. T. Phillips, State Council of Agricultural Associations; W. H. Horton, Jr., and H. R. Palmer, Pennsylvania Electric Association. C. K. Steinmetz of Harrisburg was appointed manager of the project.

A folder was prepared, entitled "The Electric Farm", in explanation of the organization and purpose of the exhibition, which gave the appliances on exhibition and the consumption of electrical power under the headings: Bathroom, bedroom, dining room, living room, kitchen, barn-shed-yard, poultry house, dairy, workshop, garage, and miscellaneous. As this list is rather long, amounting to one hundred and ten pieces of equipment, it is not quoted here.

In assembling the equipment there were several things to be considered, the first being to get the best piece of equipment in a particular line, and the second to get only practical equipment. As the demonstration got under way it was realized that the first was not as important as it had previously seemed, for the farmers had favorites in every line and there was not a good deal of discussion as to the various makes.

The second was the paramount issue of the show and there was a great deal of argument both pro and con. To give the farm the atmosphere of a show it was necessary to keep as much of the equipment moving as possible so as to attract and hold the attention of the visitors. The farmers were confused to some extent by the number of motors on the place, though the guides were careful to explain that only one of each size was necessary.

The house was equipped with a single representative of every possible kind of electric appliance, and the house display alone attracted a great many of the Harrisburg people for it was truly a revelation in electrification. The electrification for the house proved to be truly a drudgery chaser for there were an electric floor scrubbing machine, electric refrigerator, stove, meat grinder, and others almost without end.



One view of the electric farm demonstration

The barn was the greatest attraction for the men for it was as light there as in the house. All the wires were in conduit and all the fixtures were vapor proof. The lights were protected first with a heavy plate glass jar which screwed into the fixtures and was sealed with a rubber ring and second by a light metal grid.

Since the exhibit was purely educational and it was desirable to do away with the annoyance of salesmen, we took five of our students down to do all the demonstrating and explaining. No mention was made of the cost of the equipment, cost of power, or method of obtaining electric service, since the conditions vary so widely in the different power territories. It was an exhibition to show the farmer how he could intelligently use electricity on his farm.

The practicability of some of the equipment was questioned, but largely on account of the size. Where questions were raised they were dealt with by explaining that the piece of equipment was primarily for community use.

A motion picture story of the farm was taken by the Visusgraph Company of New York for the Philadelphia Electric Company. The story contrasted the old and the new in farm work. Sufficient copies of the film will be made so that they may be shown in all parts of the country in addition to the bits which will appear in the film weeklies. If you are interested in obtaining a copy for local show, we suggest that you get in touch with the Philadelphia Electric Company, of Philadelphia.

## Research on the Duty of Water

THE division of agricultural engineering at the University of Montana, as reported by Prof. H. E. Murdock in charge of the division, is devoting a large part of its time to a research study of the duty of water on various crops in the northern part of the state. The work was started several years ago, when a study was made of the water application the farmers were making on the Valier project. Several farms were included in the study each year until finally the work was narrowed down to two farms in 1923, and last year to only one farm which the division is operating itself. This is an 80-acre irrigated farm and has been leased for the purpose of the investigations.

The experiments have not been conducted a sufficient number of years to give definite results, but in 1923 some very interesting information was obtained.

The Valier project is located in a region which gets almost enough rainfall to produce crops without irrigation. The tendency of the farmers, therefore, is not to irrigate until forced to do so by the suffereing of their crops from lack of water. Irrigation is expensive and, if the farmers can get enough rainfall to produce the crops without irrigation they generally try to do so. The experiments have already shown that waiting for rainfall is a mistake and that irrigation should be carried on without attention to the rainfall. The experiments also indicate that early irrigation on hay crops gives better results than putting off irrigation until late in the spring.

Another thing which the investigations have indicated is that low crop production on the Valier project is largely due to a lack of available soil fertility, and the solution for this difficulty lies in introducing a crop rotation which will put into the soil some fertility that is adapted to irrigation farming.

Three rotations have been started from which it is expected good results will be obtained. The crops will of necessity include one legume and a cultivated crop to control the weeds. As an experimental rotation, a three-year rotation consisting of corn followed by wheat, with which clover and timothy seed are sowed, has been adopted.

# An Outstanding Engineering Service *

By Herbert Hoover

Secretary of Commerce—First President of American Engineering Council

OF the $3,069,000,311.22 spent last year in the conduct of the United States government only about $69,000,000 was spent in the productive services of the government. I am convinced that those services are bringing to the American people in added national wealth and to the nation's treasury directly literally hundreds of millions of dollars, or perhaps billions in increased national wealth on one side and hundreds of millions of dollars in available taxes on the other.

The province of the government in the conduct of its scientific services, in the conduct of many of its activities which make directly for an increment of national wealth, has only been touched upon in public welfare.

I believe that during the last five years it has been vitally necessary for us to have our expenses reduced to the lowest possible limit. It has been necessary as a part of an act of economy, but the time seems to me to be approaching when the American people will get a better realization of the character of the government spending.

Those of you who go back five years to the time when we first instituted American Engineering Council will recall that our first large activity in research was in the subject of "Waste". That was indeed a work of national importance. and for the first time it had been brought to the attention of the engineers, the scientists and the public that something was wrong in our economic system.

The Department of Commerce took up the work of making effective, so far as might be within the limitations imposed by the director of the budget, the possible accomplishment outlined by the American Engineering Council investigation.

We have actually spent something like $100,000 a year in that work, and today, by careful cultivation, by an in- this problem in every conceivable direction, I have no hesitation in saying that the reduction in waste in our economic finite amount of negotiation and conferences, by striking at system exceeds $600,000,000 per annum. This has all resulted following the original report of the Council's Committee on Elimination of Waste in Industry.

The establishment of standards, the economies which they bring in production and distribution. the elimination of unnecessary varieties, the establishment of specifications, the vast improvement in our statistical services and the stability they give to business, have all of them contributed amounts estimated by those engaged in industry that far exceed the figures which I have given to you, and I think we spent but about $100,000.

It is a curious fact in that relation that were it possible under our form of government to recruit money by public subscription for the expense and continuation of that work, here would be no difficulty in raising that sum, or from one to five millions of dollars per annum from the trades themselves, so much do they appreciate the possibility of a government service of a reproductive character.

I am not asking the director of the budget to increase our appropriation to $5,000,000 or even $1,000,000 a year. Perhaps when I go to him I may ask for only $25,000, but I do suggest that the time is rapidly approaching when a review of the real productive services of the government, a review in the interest of the American people themselves, will result in more liberal treatment of all branches.

No one is more interested in this than the engineers of the United States, for it is through the elimination of waste and the increase in our national efficiency that we can hope to reduce the cost of living on the one hand, and to increase the standards of living of our people on the other.

There is no panacea for all of our economic troubles, but it is a certainty that the elimination of waste—and I speak of it not in the narrow sense but in the sense developed by all of our scientifiec and economic bureaus—is in itself an asset and not a liability.

Our economic system has grown up out of the magnificent effort of individual concerns beyond that of any other country in the world, but at the same time the whole character of our people has led them to an extreme of individualism, and today we need and indeed we are gaining a collective action in the elimination of broad economic wastes that arise directly from this individual action.

It is at least a tribute to American Engineering Council that it should have launched a campaign five years ago that has come to have such a general acceptance and general respect throughout our industries and trades that the Department of Commerce is totally unable to accomodate the demands made upon it for actual time, and today we are asking industries to delay their conferences and their programs for three or four months ahead in order that we may get to them. It is indeed a monument to the value of American Engineering Council as a contribution to public welfare.

Those of you who have worked in the Council these last four or five years have realized the difficulty of keeping it alive, but if all our brother engineers, who have not yet come to our support in this Council, could be brought to realize that in accomplishment this Council has done more for public welfare than our engineering societies have done in the whole period of their existence, we might indeed gain some strength that we so badly need in our immediate support here.

American Engineering Council has a budget of its own. Its budget officer is never worried about keeping down expenditures because he does not have the money to spend but nevertheless the Council in the work which it is performing is bringing revenues not alone to the American government, but a vast amount of accomplishment to the American people.

I trust that the American Engineering Council may go on and gain in strength. I am in hopes that the reorganization which you undertook a year ago will make it possible for some of our engineering brothers to come more amiably into line. It may be we will have to wait for the death of some of the older members of some of the societies, but we can at least live in hopes, and in the meantime we must keep the Council alive, for if the institution can go on, and if it can produce not once in five years, but once in fifty years, the beginning of a great national conception in the change in our economic system, such as was produced five years ago, it will warrant its existence and all of the labor which you gentlemen have devoted to it.

*From an address at the annual dinner of American Engineering Council, Washington, January 16, 1925.

## Standardization of Transmission Chains and Sprockets

THE scope of a project on the standardization of transmission chains and sprockets which will be carried forward under the regular sectional committee organization, under the procedure of the American Engineering Standards Committee, has been tentatively drafted as follows:

"Formulation of American standards for transmission roller chains and sprockets teeth based on the standards already adopted by the Society of Automotive Engineers. the American Society of Mechanical Engineers and the American Gear Manufacturers Association; and the study of the possibilities of standardizing the so-called silent type of transmission chains and sprocket."

# Operating An Iowa Farm Without Horses *

By Roy E. Murphy

Superintendent, Forestdale Farm, Des Moines County, Iowa

THE good old buggy horse which we were so proud of not so long ago has had its day and gone, and not far distant is the day when the same will be said of our draft horses or our work horses as we call them on the farm.

Several years ago I purchased a two-row motor cultivator of a well-known concern in Kansas and tried it out, at the time a little doubtful as to the practicability of it myself, but willing to be convinced one way or the other.

It was a decided success, and last spring I purchased the second one of the same make.

By purchasing this machine we were able to do away with four head of horses which we had been keeping about ten months of the year when we really did not need them at all, just in order to have them during corn cultivating season, and because they were exceptionally well trained for that particular job. They sold for six hundred dollars.

We estimated the saving in maintenance cost at $15 per head per month—for the ten months to be $600—or a total of $1200 as against $870, the initial cost of the machine. This left a balance of $330 on the correct side of the ledger, which more than absorbed the depreciation and operating costs for two seasons. We found that we could do just about as much cultivating with the one machine and operator as with three teams and men.

After a few seasons with this machine, we were convinced that it was a success, and then the thought—why not do all the work on the farm with motors instead of horses?

In April 1923 a large tractor was purchased. With this we did our breaking, disking, harrowing, pulled our separator and silage cutter, and naturally we did away with another team of horses. In April 1924, a small tractor was purchased which we could use to do our mowing, planting, and also cultivate with, and to this equipment was added a one ton truck and again two teams were disposed of. Thus a 200-acre Iowa farm which, a few years ago, boasted of nine and ten head of horses now is without any.

Now after having successfully operated this 200-acre farm for about a year without a single horse, I want to give you some of the facts and figures we have obtained. In the first place the horse is the most expensive power we can possibly employ. An Iowa farm paper published in May of last year gives the cost of keeping the average farm horse, worth $175, weighing 1400 pounds and of an average age of six years, as about $180 per year.

One hundred and eighty dollars turned into corn to feed hogs will produce about twenty-seven hundred weight. At the prevailing prices it will represent a profit of approximately $70. That is cutting down the overhead some. Should you add that $180 worth of feed to your horse, he will not be worth any more than when you started feeding it to him.

In operating without horses, we find that we do our work more efficiently. We get more work per man-hour, and the men are in better shape to start their day, because of the shorter hours and time they have had to recuperate the evening before. We do not have to work until seven or eight o'clock to accomplish the day's work. We get into the field at seven o'clock in the morning and quit between five-thirty and six in the evening, and we don't have to spend another forty minutes to two hours taking care of six to ten head of horses.

Before we started motorizing, we had nine head of draft horses on the place. Today we don't have a single one, and we have done everything on the farm, completed the entire cycle of farm work without them, and everyone is much happier over it.

Just to cite some instances of the labor it saves, we had a field of twenty-one acres that we drilled in wheat a year ago last fall. It took eight and a half hours using two men, two drills and three teams. This year we drilled the same field in six and a half hours, using tractor, one man and a drill.

The same article referred to above gives the cost of operating man and team per day in 1918 as $8.26. Today and in the past year some of the items of feed, etc., have been higher and some lower, so we will take for convenience $7.50.

COMPARISON OF COSTS

| | | |
|---|---|---|
| Horses— | | |
| 17 man-hours at | $ .20 | $ 3.40 |
| 17 drill-hours at | .30 | 5.10 |
| 25½ team-hours at | .40 | 10.20 |
| | | $18.70 |
| Tractor— | | |
| 6½ hours (tractor) at | $1.00 | $6.50 |
| 6½ drill-hours at | .30 | 1.95 |
| *6½ man-hours at | .30 | 1.95 |
| | | $10.40 |

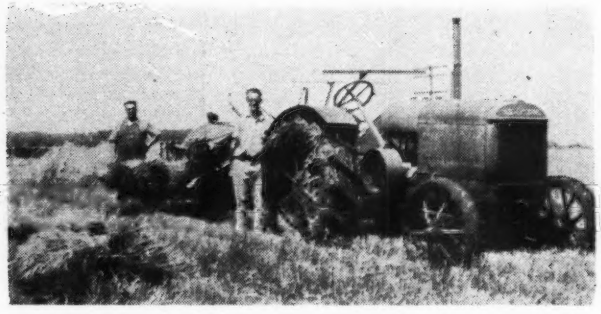
*Some will contend that a tractor operator must have more experience and be a higher paid man, so I have charged the tractor operator at 30 cents, but it was the same man operating the tractor that had driven the horses the year before.

Eight dollars and thirty cents makes a nice increase in the margin of cost of production and selling price.

We have been able to do our planting, cultivating, and

*This article is an extension of an impromptu talk before the meeting of the Farm Power and Machinery Division of the American Society of Agricultural Engineers, Chicago, December 3, 1924.

Roy E. Murphy, superintendent of Forestdale Farm, and a group of his farm equipment



The grain harvesting outfit used on Forestdale Farm

Mr. Murphy's tractor used for loading hay in the field

shucking without horses, and we have done it much more economically than we could have done it with them.

In planting, we did twenty-four acres in eleven hours at a cost of approximately $13.00. With teams at $7.50 a day it would have cost about $18.00.

Cultivating seventy-two acres, forty-eight the long way and twenty-four crossing, first cultivation, the total cost using two-row motor cultivators was $24.00. Could that figure be duplicated with horses?

In six days with tractor and mechanical corn picker we shucked and cribbed 2400 bushels at a cost of 13 cents per bushel, including use and depreciation of machine and tractor, man labor, fuel and oils.

The cost of producing our grains has been much lower than any in the community, and we have kept very close track of it, because we did not want to disillusion ourselves about this proposition. We wanted to know exactly whether it was costing us more or less to use machinery instead of horses. Having used the horses previously and this year the machine and tractor power, we know exactly what it represented in profits. And the most important item, I think, of the motorization proposition, is reducing the gamble with the weather. The farmer is always gambling with the weather more or less, and by using the engines you can start early in the morning, and if necessary you can go as long as you can see by changing off operators; you can go right through meal hours; you don't have to stop it at the end of a row and let it blow, and you don't have to bother with it fighting flies. You can go right straight through as long as you have drivers to change off; the machine can stand it.

In plowing, it far excels the horses. Here is a good example of what can be done on similar plots with horses and tractor. The tractor went into the field in the morning at four o'clock. A little before six that evening it pulled out having plowed nineteen acres, plowing about eight inches deep. The cost was about six dollars for that day's work including fuel, oil, the man's labor and depreciation on the machine for that fraction of its life, and my neighbor across the road used five head of horses, four and one-half days and plowed twenty acres about five inches deep. When we figured the cost of man and team at seven dollars and a half per day, the tractor there represents some saving.

In harvesting our corn we were able to get the corn out and the ground fall plowed. We saved the time and labor it would take in breaking and burning the stalks and we did not lose the stalks. We turned them under and had a perfectly good fertilizer there, and we will be able to get the weeds out in a wholesale fashion with the disk next spring rather than spending our time plowing.

In putting in our hay, a good many told us that this was the place where we would fall down—that we simply could not harvest a crop of hay without the use of at least one horse for pulley work. But in that place we brought in the use of our motor truck, and it worked very nicely. We put up three crops of alfalfa and got it into the barn each time much more quickly than we were ever able to do using the horses.

We always have a large number of hogs and cattle on feed, and we find that with the small tractor we can get around the feed lots much more quickly with manure spreaders and wagons than we could while we were using the horses. We haul larger loads and cover the ground much more rapidly.

The small tractor comes in very handy in tearing down old fence, old sheds, stretching wire and many other such jobs. Also in plowing and cultivating small garden plots, potato patches, and such. And the beauty of it is it does not eat when it is not working.

I wonder some times how we ever figured that we could get along without the motor truck. We certainly think it would be impossible now.

In marketing our hogs, we can take the same number to the stock yards with the truck in two hours that it used to take us a full day using two teams, and the shrink is almost nothing because they are on the road such a short time.

At threshing time, it played a very important part in moving grain to the elevator, taking a load of fifty bushels of wheat and carrying a trailer with about the same load. This was on paved road.

I know some will say tractors could not be used on all farms. I appreciate that the topography of a farm determines the extent of using a tractor, but we should use tractor power in every place we possibly can instead of horses. And if one will "read and follow" his instruction book he will find that it does not necessarily require a mechanic to operate a tractor. The tractor will work all right if kept well lubricated, and not subjected to an attack of "tinkeritis" brought on by the operator.

I am convinced the way to farm is with tractors. That is the easiest way to cut down production costs. We can't always regulate the price we are going to get for our crops, but we can regulate, to some extent, the cost of producing them and thereby increase our margin of profit.

EDITOR'S NOTE: Mr. Murphy's accomplishment in completely motoring his farm is one of the finest examples of its kind we have seen. It is such instances that indicate real progress toward an engineered agriculture, and it is to the best interests of agricultural engineering and agricultural engineers that they be discovered and set up as an example for the benefit of all farmers.

Partial view of farmstead at Forestdale Farm

# Research in Agricultural Engineering

Research activities in the agricultural-engineering field are presented under this heading by the A. S. A. E. Research Committee. Members of the Society are invited to discuss material presented, to offer suggestions for timely topics, and to prepare special articles on any phase of agricultural engineering research

## Soil Colloids and Tillage

By R. W. Trullinger

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TILLAGE of soil, the basic agricultural operation, has for its primary purpose the production of certain degrees of so-called tilth in soil which will permit the optimum germination, growth, and yield of crops. Agronomists have determined the approximate degrees of tilth best suited to the maximum production of certain crops in several soils. Agricultural engineers have, in addition, been attempting to devise methods for measuring and designating different degrees of tilth in different soils in a a more or less specific manner, and with these as a basis to standardize degrees of tilth for each crop or class of crops. The importance of this naturally is quite evident when the specific purpose of tillage is considered.

It seems strange, however, that tillage, which is perhaps the oldest, most extensive, and in many localities the most important agricultural operation, is relatively the least known. Tillage processes and tools for accomplishing them have been experimented with from time immemorial, and while the tools themselves have admittedly been improved to a large degree, relatively little has been learned as to the exact nature of the factors governing tillage beyond certain empirical deductions.

Since tillage is one of the greatest if not the greatest power-consuming agricultural operation, much study has been undertaken to determine ways and means of reducing the power requirement of tillage machines during the production of desired tillage results. This has naturally resulted in the special shaping of tillage tool surfaces for various purposes and has established the broad general fact that different soils require different tools and shapes thereof to produce the desired tillage results.

In this connection the economic necessity of determining the specific nature and value of the factors which affect or govern the production of desired states of tilth in different soil types by tillage machines has recently become evident. In addition the practical importance of standardization of useful machines and the elimination of the nonessential types has indicated the necessity of a more fundamental knowledge of tillage processes and a corresponding development of tillage machinery.

Studies conducted on the basis of these considerations have led to the quite general agreement that such soil dynamics factors as cohesion, adhesion, plasticity, tensile strength, shearing strength, compressive strength, internal and external frictional characteristics, moisture content, physical and mechanical composition, and possibly others quite materially influence the efficiency and economy of tillage practices.

Apparently, however, there has been but little advance beyond this point. It has been comparatively easy to demonstrate that soils possess these properties and that they exert practically a controlling influence on tillage, but attempts to learn their nature and evaluate them in terms of their specific influence upon the accomplishment of preconceived tillage results have met with but relatively little success.

Obviously there is a reason for this. The indications are that there must be some prevalent characteristic of soil which can uniformly control the nature and value of its dynamic properties. An examination of the long history of tillage experiments covering almost the entire range of soil types and almost every conceivable design of tillage implement does not give a hint as to the existence of any one governing characteristic. A careful study of this experimental work has revealed one thing, however, which seems to have been common almost throughout. This is that soil has been uniformly considered to be a static, inert substance, subject only to the laws of gravity and structural mechanics as far as tillage is concerned—in other words, a dead load to be treated as such.

The failure of investigations, based upon this conception, to yield anything tangible as to the nature of the dynamic properties of soil seems to cast doubt upon its validity. Agriculturists have for years looked upon the soil as a living thing. Why then can it not be considered as a dynamic living body with reference to tillage?

The results of tillage experiments in this country and abroad have uniformly agreed that moisture content and cohesion of soils, for instance, are two of the most important factors affecting tillage. Tests of the draft of plows by the French Machine Testing Station showed that the draft varied directly with the nature, condition, and moisture content of the soil, regardless of the construction, weight, and speed of operation of the plows. Tests at a number of agricultural experiment stations in this country have added emphasis to this finding. Studies in New Zealand on plow dynamics led to the conclusion that the controlling factors of plow draft lie mainly in the soil itself.

Studies in this country indicated the necessity of so designing a plow moldboard that it will interfere a minimum amount with the crumbling of sticky soils. The condition of the soil was found to be one of the chief causes of failure of moldboards to scour, regardless of their shape. Moisture content, cohesion, adhesion, and frictional characteristics of soils were found to impose uniform requirements on plows of any design. Experiments in France to compare moldboard with disk plows showed that the relative efficiencies of these plows could be reversed by varying the conditions of the colloidal materials in the soils.

In view of these indicative results an investigation was made into the history of research in soil physics and chemistry, more especially during the past 15 or 20 years. In this connection it was found that the U. S. D. A. Bureau of Soils some years ago indicated the rationality of viewing the soil dynamically. In addition it was found that a long line of studies of soil physics and chemistry dealing primarily with the properties and functions of colloids and similar materials in soils and their influence on soil dynamics factors has been conducted on the one hand, and, entirely independently thereof, a long line of studies of soil tillage and tillage machinery has been conducted on the other. Strange to say, these two lines of study have been parallel and intimately related, but apparently they have been entirely separated by a wall of lack of cooperation between soils specialists and agricultural engineers.

### General Nature of Soil Colloids

Much work has been done on the general nature, tendencies, and properties of soil colloids which may bear on the physical factors governing tillage. In this connection studies at the Massachusetts Agricultural Experiment Sta-

tion showed that the colloids present in soils may be conveniently divided into inorganic and organic colloids. The forms commonly comprising the inorganic colloids are silicic acid, and the silicates, aluminum hydroxide and its compounds with silicic acid, and iron hydroxide. The organic colloids include the humic compounds and the various kinds of microorganisms like the soil bacteria and fungi, and the mucinous substances which are secreted by such organisms. Both of these types of colloids are capable of showing adsorption and absorption. Adsorption is believed to be very small, whereas absorption is quite large, depending upon the chemical nature of the reactive colloids. Subsequently a Russian experiment station established the general fact that soil colloids represent the active portions of soils and govern their physical properties and that the absorptive capacities of soils are proportional to their contents of colloidal material. German experiments established in addition that the absorptive power of true clay is a measure of its other physical properties, especially its plasticity.

The U. S. D. A. Bureau of Soils in further work revealed the existence of so-called ultra clay in soils which gives every evidence of being a true colloid. When moist this material was found to be very plastic and sticky, and when dry it was, up to 10 per cent, a stronger binding agent than Portland cement. It is considered evident by that Bureau that ultra clay is the principal binding material of soil, giving it plasticity, cohesiveness, or hardness according to the moisture content. It was further found that the nature of true soil colloids is quite different from that of finely divided noncolloidal minerals, and that more than 95 per cent of the total absorption of soil is due to the colloids.

The U. S. D. A. Bureau of Public Roads also found that, in general, moisture equivalents increase with the percentage of very fine silt and clay in soil, and that there is a fairly definite relation between the moisture equivalent and the mechanical analysis. The bearing power of most soils is not appreciably reduced by the addition of moisture up to the moisture equivalent, but saturation beyond this point causes a rapid reduction in bearing power. Thus an almost direct relation between colloidal phenomena and bearing power in soils through the medium of moisture equivalent is indicated.

Other studies in this country showed that plasticity in clays is due to their gelatinous state, a state common to them because of their mode of origin. This gelatinous matter may be silicic acid gel, alumina gel, iron oxide gel, silicate gel, or organic gel. Two or more of these are usually present and their effect is further modified by absorbed salts and the relative proportions of large and small grains and to a limited extent by the shape of the grains. The particular kind and amount of gelantinous matter present, the size and shape of grain, and the relative proportions of large and small grains are also important factors in determining the other related physical properties such as tensile strength. These findings thus indicate how important colloidal phenomena in soils may be in the evaluation of dynamic factors.

### Specific Properties of Soil Colloids Affecting Soil Dynamics Factors

It is well known that the properties of cohesiveness and firmness in soils act directly in resisting the processes of tillage. A knowledge of the specific properties of soil colloids which might influence cohesiveness and firmness would thus seem to be quite important. In this connection comparative investigations in Germany indicated wide variations in the cohesive powers of a large number of soils samples, which in the great majority of cases were more marked in the upper strata of soil than in the deeper ones. Coherence increased with a decrease of the coarse sand and in increase of fine silt and the cohesive power of dry soils was found to be affected to a considerable extent by the physical properties of the individual soil constituents, more especially those of colloidal fineness.

Studies in Holland on the constituents of clay which impart plasticity and cohesion showed that the minerals biotite, hematite, and limonite and mixtures of hematite or limonite with kaolin possess typical clay plasticity combined with a high degree of toughness. Those minerals and mixtures which appeared plastic showed a leafy or scaly structure. A high degree of toughness was found in washed products of biotite, hematite, and limonite as was also a high degree of firmness on drying in fine washed products out of the same minerals. Since firmness was not found in all of these products it was concluded that a high degree of firmness and toughness is a property only of the scaly shaped particles of colloidal size.

Further studies in Holland on the physical properties of soil grains and on plasticity and other physical properties of whole soils which affect tillage indicated that mechanical analysis alone is not adequate for distinguishing the properties of different classes of soil in this connection. This point is particularly important, since the majority of tillage studies have been based largely upon simple mechanical analysis. The Dutch experiments indicated the necessity of a knowledge of all of the physical properties of the different grades of soil, including especially hygroscopicity, pore space, capillarity, water capacity, flocculating properties, Brownian movement, etc. Since many soils were found to be rich in ultra-microscopic bodies it was concluded that these properties will be determined largely by the nature and properties of the colloidal bodies present. A system of classifying such soils by their varying degrees of colloidal plasticity was suggested, in which soils containing more than 50 per cent of coarse sand from 0.02 to 2 mm. in size are considered to be dry sandy soils. Soils containing more than 50 per cent of fine sand from 0.02 to 0.2 mm. or silt from 0.002 to 0.02 mm. are classed as loamy clay, normal loam, or loamy sand. Soils containing more than 50 per cent of colloidal particles of 0.002 mm. or less in size are classed as very heavy, tough and highly plastic clay soils. It was concluded to be very important to determine the degrees of plasticity, fluidity, stickiness, and resistance to rolling out in the last class of soils, especially when undertaking tillage investigations.

Other studies in this country on the phenomena of clay plasticity showed that the strength of clay whether plastic or dry is due to molecular cohesion of the clay particles themselves. Water when added to a mass of dry clay was found to produce a disruptive force within the mass opposing cohesion and reducing the strength of the clay. Plasticity was found to result from a balancing of the forces of cohesion and disruption. This work throws light directly on the activity of moisture on the colloids in clay soils with reference to their resistance to tillage.

These studies are only a few of the large number which have been conducted on the physico-chemical aspects of soils. However, they are sufficient to show rather strikingly what a strong bearing and influence the colloidal properties of soils may have upon the physical factors controlling tillage. Since these active bodies in soils have been definitely recognized in many cases as distinct types of colloids, it would therefore seem that the aid of some of the laws of colloid chemistry might be invoked with a view to so controlling the soil colloids as to favor the processes

At the left is a spillway for a terrace, and at the right is shown the water pouring over the end of the same terrace. Photo by courtesy of farm mechanics division, Purdue

of tillage. It is also well known that treatments are applied to soils to make them a better habitat for crops. It might also seem reasonable to consider how soils might be treated or managed so as to improve their "tillability".

### Moisture

Obviously anything which will make it more easy to overcome the cohesive and adhesive properties of soils will be distinctly favorable to tillage. Some of the results noted above indicated that moisture is a factor to be considered in this connection. Apparently in following up this line of investigation, comparative tests in Germany on the influence in cohesion values, and minimum cohesion can be observed of cohesion on the draft of plows showed that moisture content is the most important factor determining the variation in each soil at a moisture content corresponding to its individual character. Further experiments on the draft of a model plow in artificially compressed soils showed that the draft increased with increasing compactness of a uniformly damp sand soil at a rate greater than a proportional rate. The draft also increased with increasing dampness up to a certain limit and then decreased. In a soil dampened irregularly, however, the draft increased with increasing dampness. Similar results have been obtained by several investigators in this country. Studies in France showed that the best results were obtained with the least expenditure of energy in plowing when the soil contained from 11 to 17 per cent of moisture, depending upon its physico-chemical characteristics. Below this range of moisture content the draft increased.

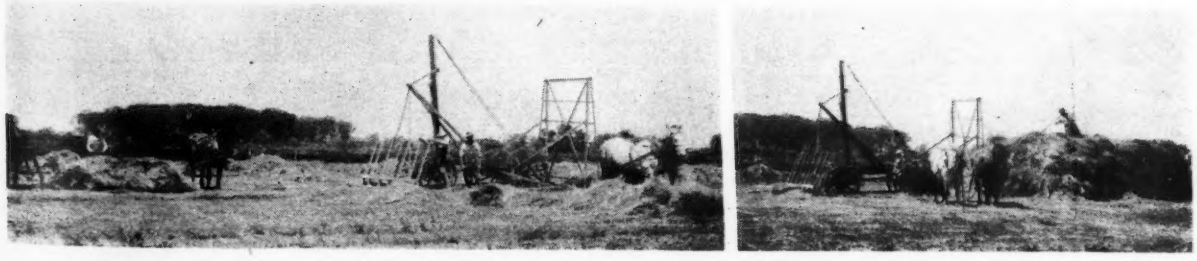
In experiments at the Rothamsted Experimental Station it was roughly estimated that one-third of the total work done in plowing is expended in overcoming the adhesive or frictional forces between the moldboard surface and the soil. In this connection an electrical method of reducing this frictional force was devised which depends upon the phenomenon of electro-endosmose exhibited by moist soil. It was found that by virtue of the negative charge of the soil colloids, water will move through moist soil toward the negative electrodes under the action of an electric current. If a current was passed through the soil having the moldboard of the plow as the negative electrode, the film of water formed at the soil-metal surface acted as a lubricant and reduced the plowing draft. Going a step further, experiments in Germany with sand, loam, peat, and three different garden soils, to determine the influence of moisture content and physical condition on the resistance to cultivation, showed that when the soils contained only hygroscopic moisture they were the most easily tilled, regardless of their other physical characteristics.

Obviously then soil moisture is quite an important factor in tillage due especially to its influence on cohesion and adhesion or external friction. These results would also seem to indicate the importance of taking advantage of natural moisture phenomena in soils, especially at critical periods with reference to tillage. In addition the importance of knowing more about moisture absorption, retention and regulation in soils with reference to the specific requirements of tillage is obvious. Studies by the U. S. D. A. Bureau of Soils in this connection showed that samples of the colloidal matter from thirty-four soils which differed widely in texture, origin, mode of formation, and chemical composition exercised a relatively constant absorption of water. It was found that the colloidal matter in ing the water absorption of the soil under certain conditions the soil might even be fairly closely estimated by determin- and dividing the result by the average absorption factor.

However, experiments in Germany showed that the absorptive power for water of colloids from clay and humus soils steadily decreased after repeated drying. This may have a bearing on the difficulty frequently experienced in the plowing of heavy soils in the fall following a dry summer. Extensive studies at the New York Cornell experiment station on the influence of drying on soil colloids showed that drying a surface soil once produced as much effect on the colloidal material as repeated dryings alternated with moistenings, and produced a change in the colloidal material from which it did not immediately recover on being wetted. On the other hand, there was an accumulative effect in subsoils due to alternate wetting and drying. This may have a bearing on the striking differences in the physical properties of surface and subsoils frequently observed in certain soils during tillage. The absorption of water vapor was not materially affected by variations of from 5 to 10 degrees between temperatures of 15 and 40 degrees C. This would seem to indicate that temperature is not always an important factor in the moisture relations of some soils. The difference in hygroscopity between a moist and air-dried soil was found to persist for three months at least, while the remoistening of air-dried soils to a moisture content above that originally held did not cause a reversal of hygroscopicity immediately or within three months. The alternate wetting and drying of soils did not affect the hygroscopicity after the first drying but subsoils that had been wetted and dried thirty-two times showed a significant accumulative decrease in hygroscopicity. Hygroscopicity decreased with air drying. Long immersion under water increased the hygroscopicity of a soil poor in organic matter and decreased it in one rich in organic matter. Leaching a soil increased its capacity to absorb moisture.

These results are quite significant as far as they go. They show that hygroscopic moisture is probably the active moisture affecting tillage, and that the reciprocal relations of soil colloids and soil moisture are likely to have a controlling influence in the maintenance of conditions most favorable to tillage. They also indicate strongly that external influences such as weather and temperature may have a bearing on this relation and argue the importance of learning more of the fundamental details of such action. In this connection studies at the Woburn experimental fruit farm in England on the distribution of clay particles in a soil showed that rainfall may influence the amount and distribution of fine particles to a depth greater than 12 inches and that the effect of rain on the flocculation of a soil may be amply sufficient to cause considerable difference in its behavior on different occasions. Obviously this would apply especially to tillage. Comparative studies on the relation of the percentage of shrinkage of a number of soils and their moisture residues at permanent wilting and the percentage of moisture in the soil at the point of maximum plasticity showed that the amount of shrinkage exhibited by a soil on air drying is not determined solely by its colloidality or degree of dispersion, but is dependent also upon the degree of aggregation of the particles into compound grains. In addition, diffusion of soil colloids was considered to render the soils impermeable to water, especially under conditions of prolonged heavy rainfall.

(To be continued in the April issue.)



With a buck rake and stack like that shown a great amount of hay can be put up in a very short time

# Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture

**Heat Treatment of Steel Springs,** J. W. Rockefeller, Jr. (Machinery, New York, 31 (1924), No. 1, pp. 4, 5, figs. 2.) Studies on the heat treatment of steel springs are reported which showed that the most common practice in the heat treatment of carbon steel springs is to quench in oil at about 1,450 degrees F., and subsequently to draw at from 400 to 800 degrees. The best fatigue-resistant properties were found to be developed in a one per cent carbon spring steel by quenching at from 1,460 to 1,480 degrees and drawing at about 650 degrees. The elastic limit of a spring steel could be increased by raising the quenching temperature up to at least 1,600 degrees. In general it was found that alloy steels require a combination of higher heat treating temperatures than carbon steels, if their best properties are to be brought out.

**The Viscosity of Oils at High Temperatures,** A. R. Fortsch and R. E. Wilson. (Industrial and Engineering Chemistry, Washington, D. C., 16 (1924), No. 8, pp. 789-792, figs. 3.) Due to the lack of data on the viscosity of oils at temperatures above 212 degrees F., data and curves covering viscosity determinations on a wide variety of oils from Midcontinent and similar crudes up to a temperature of 495 degrees are presented. The curves are discussed and a method of interpolation is outlined by which it should be possible to obtain to within a few per cent the viscosity of practically any oil derived from Midcontinent or other intermediate base crude at any temperature up to 550 degrees given a single reliable determination of its viscosity at ordinary temperatures.

**Investigations in Stump and Stone Removal,** M. J. Thompson and A. J. Schwantes. (Minnesota Station Bulletin, St. Paul, 208 (1924), pp. 43, figs. 12.) Data are reported on (1) the cost of clearing in units of time and material on selected areas representing the principal tillable areas of northeastern Minnesota, (2) clearing costs in like units of such trees or stumps as are usually associated with the several types of soil, (3) cost of breaking under each condition, (4) stone removal, and (5) choice of first crops.

It was found that in general there is a more or less definite relationship between type of soil and predominating species of tree growth. White pine grows on a greater variety of soils than any other species. The cost of brushing was found to vary considerably, depending on the type of vegetation as well as many other factors. The brushing cost of Jack pine sand was comparatively low, varying on six plats from 4.3 to 40 man hours per acre. The amount of explosives required to clear an acre varied considerably, depending primarily on the size, kind, and age of stumps as well as kind and condition of soil. The variations on ten plats was from 38.5 to 130 pounds per acre, with an average of 84.72 pounds.

The cost per acre of stump removal averaged $30.59, and the total average cost of stump removal on all plats was $15.28 for labor and $15.31 for material. The cost of breaking varied from $3.44 to $11.22 per acre with an average cost of $7.90. Of the total clearing costs, 34 per cent was found to be for materials, 16 per cent for horse labor, and 30 per cent for man labor. Green stumps were much more expensive to remove than dead stumps. The factors affecting the cost of stump removal in the order of their importance were found to be size, kind, and age of stump, soil moisture content, and kind of soil.

The average time per stump for removing and piling varied from 6.7 man-minutes and 0.76 horse-minutes to 124 man-minutes and 117 horse-minutes, with an average on all plats of 52.26 man-minutes and 32.8 horse-minutes. The total cost of stump removal per stump varied from 8 cents to $1.69, with an average cost on all plats of 65 cents.

Electric blasting was found to be safer and under some conditions more economical than the cap and fuse method. Under some conditions it was economical to use a stump puller in combination with the explosives, especially with green stumps or where the stumps were large and the soil was light and dry. Better yields were usually obtained from the first crop if the breaking was relatively deep. Disking new land was not satisfactory for grain or a cultivated crop. Where the hauling distance was long it was found to be better to break up large stones with explosives and haul the pieces on a wagon. Explosives were more efficient on large bowlders than on small ones. Undermining was more efficient than underdrilling and was almost as efficient as mud capping. The best time of the year for breaking is considered to be June, July, and perhaps August. Attention is especially drawn to the importance of ample clearance space between the lower side of the plow beam and the point of the share when breaking cleared land.

**Drainage Construction on Newlands Reclamation Project,** A. W. Walker. (Engineering News-Record, New York, 93 (1924), No. 10, pp. 382-386, figs. 8.) The conditions under which over 150 miles of drain were built on the Newlands Reclamation Project are described, and the methods adopted to obtain economy and speed in construction are summarized. It is stated that the serious water-logging of the farm lands by irrigation seepage water necessitated the rapid construction of a comprehensive drainage system.

Data on the results obtained from the drains are reported, showing a general lowering of the ground water. Aside from this, the outstanding benefit is the furnishing of an adequate outlet for surface and soil drainage waters. Analyses of soil samples showed conclusively the effect of drainage in reducing the soil alkalinity.

A comparison of the composition of the drainage water with that of the irrigation water showed that when the drains were discharging freely, as during June and July, the drainage water carried about ten times as much salt as the irrigation water. Analyses covering the entire year showed that the proportion of calcium in the drainage water was much lower than in the irrigation water. In fact, the actual lime content of the drainage water was generally lower than that of the irrigation water. This is taken to indicate that there is a marked absorption of lime from the irrigation water, accompanied by a displacement of soda from the soil.

**Utilizing Poles and Timber in Farm Building,** G. Amundson. (Michigan Agricultural College Extension Bulletin, East Lansing 24 (1924), pp. 36, figs. 47.) Practical information on the utilization of poles and timber in the construction of houses and farm buildings, with particular reference to Michigan conditions, is presented. Numerous diagrammatic illustrations and working drawings of structures built of such materials are included.

## Book Reviews

**"Home Conveniences,"** by Frederick W. Ives, formerly professor of agricultural engineering, Ohio State University, is the title of one of Harper's agricultural handbooks. This book was prepared with the view of setting forth in a brief way some of the things that make for comfort about the home. It is intended to aid the householder in the selection of appliances and based on a long experience in answering the questions that arise every day concerning these matters. The book contains the following chapters: Heating appliances; ventilation; cooking appliances; home laundry equipment; plumbing fixtures and accessories; disposal of waste; refregeration for the household; cupboards and closets; cleaning devices; handy household devices; labor-saving kitchen devices; handy repairing conveniences; the electric motor and its applications; the small internal-combustion engine and its applications; lighting and light plants; septic tank; method of getting water into the house; chapter on the suggestions for reading, giving some of the important sources of material on this subject. The book contains 220 pages of text matter and 75 illustrations. It is published by Harper & Brothers, Publishers, New York City.

**"Power Development of Small Streams,"** by Carl C. Harris and Samuel O. Rice, is the title of a book which has been written to furnish the laymen a practical and working knowledge of the installation and operation of small water power plants for furnishing country homes, towns, and villages with electric light, power, heat, water supply, and fire protection. The language used in the book is non-technical and is written for the lay reader. The chapters in the book cover such subjects as water wheels; measurements of a stream's capacity to develop power; electricity in the home; dams; conduits; position of water plants; and important technical data for water power users. The book contains 180 pages of text matter and is well illustrated. It is published by Rodney Hunt Machine Company, Orange, Massachusetts.

**"The Small Home—How to Plan and Build It,"** by William Draper Brinckloe, is a new book containing sixty practical plans for low cost bungalows, cottages, farm houses, apartments, garages, and barns. The author is a member of the American Society of Agricultural Engineers and charter member of the American Institute of Architects. His wide experience and success in his field makes this work especially valuable. The book contains chapters on selecting the site, counting the cost, plans and specifications, materials, home elecric heaters and fireplaces, porches, water and waste, plumbing, the owner his own builder, making over the old home, the garage, farm house problems, fixings and furnishing. The book contains more than two hundred pages, half of which is devoted to the sixty plans mentioned. The book is published by Robert M. McBride & Company, 7 West 16th Street, New York City.

# News Section

## On to Madison!

EVERY agricultural engineer and everyone interested in or associated with any phase of agricultural engineering—and especially every member of the American Society of Agricultural Engineers—should draw a red circle around the dates of June 22, 23, 24, and 25, and set aside that week for attendance at the nineteenth annual meeting of the American Society of Agricultural Engineers, which will be held at Madison, Wisconsin. The main objective of the "A. E. F." (agricultural engineering forces) for the next three months should be to reach Madison on the early morning of June 22, prepared to spend the entire week in attendance at the most inspiring and otherwise helpful meeting the American Society of Agricultural Engineers have ever staged. Let's all go!

The local arrangements committee at Madison, under the able direction of Prof. E. R. Jones of the department of agricultural engineering at the University of Wisconsin, started intensive preparations for the meeting some time ago. Everyone who attended the meeting at Lincoln, Nebraska, last year cherishes the memory of the most wonderful time and the best annual meeting the Society has ever had. The Madison committee on arrangements is determined that no one attending the annual meeting there in June is going to be able to say that he had a better time at Lincoln than he did at Madison. John Swenehart, one of Prof. Jones' able lieutenants, who will handle the "dynamite" during the week of the meeting, says the meeting will go off with a bang that will be felt from start to finish.

The Meetings Committee is arranging for a most excellent program. According to arrangements that are being made at present, the first day of the meeting, June 22, will be devoted to field demonstrations, inspection trips, committee meetings, etc. It will be of special interest to agricultural engineers to know that an inspection trip through the U. S. D. A. Forest Products Laboratory at Madison has already been arranged; this will be an opportunity that no one in attendance at the meeting should miss.

The meeting will be formally opened Tuesday morning, June 23. The general plan of the meeting that is being considered at this time is to devote the entire day of June 23 to meetings of the professional divisions. The annual business meeting is scheduled for the evening of June 23.

The third day, June 24, will probably be devoted to a general session, at which time speakers of national prominence will be heard on subjects of interest to those engaged in all phases of agricultural-engineering work. The purpose of this session will be to give all agricultural engineers an understanding of the problems confronting members in all phases of the work and to bring out the relation which all branches of agricultural engineering bear to each other.

The annual banquet of the Society will be held on the evening of June 24. Special arrangements are being made to make the banquet an especially attractive and enjoyable affair, and anyone who attended the banquet at Lincoln, Nebraska, last June will certainly not stay from the one at Madison. The inspiration and enjoyment one receives from an A. S. A. E. annual meeting reaches the climax at the banquet.

The fourth day, June 25, will be given to the College Division for the discussion of problems in connection with teaching methods in agricultural engineering, research, and extension. It is planned that special emphasis will be put on the matter of research.

Following the annual meeting a conference on rural electrification of special interest to agricultural engineers in attendance at Madison will be June 25 and 26, under the auspices of the national Committee on the Relation of Electricity to Agriculture.

## The Tractor Meeting

WHAT promises to be the most outstanding meeting in the history of the tractor industry, from the standpoint of discussions of fundamental importance to engineers interested and actively engaged in tractor development, is the two-day cooperative tractor meeting to be held under the auspices of the American Society of Agricultural Engineers and the Society of Automotive Engineers at the Great Northern Hotel, Chicago, April 29 and 30. The program for the first day is being arranged for by the American Society of Agricultural Engineers and will be devoted exclusively to the agricultural application of the tractor. The Society of Automotive Engineers will have charge of the meeting for the second day, the program of which will be devoted to tractor production methods and internal-combustion engineering as related to the tractor power plant.

Both formal and informal discussions by engineers and others interested will follow the various papers scheduled. All who are in any way interested in tractor development are cordially invited to attend this meeting. A special luncheon on each day will be a feature of the meeting, The evening of April 29 will be devoted to the showing of motion picture films, in which the application of the tractor and modern tractor production methods will be featured. Following is a tentative program of the meeting.

### TENTATIVE PROGRAM

A. S. A. E. and S. A. E. Cooperative Tractor Meeting
Great Northern Hotel, Chicago,
April 29 and 30, 1925.

#### A. S. A. E. PROGRAM—APRIL 29

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|---|---|
| 9:30 A. M. | PAPER: "The Relation of Soil Dynamics to the Problem of Tractor Lugs" By M. L. Nichols, professor of agricultural engineering, Alabama Polytechnic Institute |
| 10:00 A. M. | Discussion |
| 11:30 A. M. | PAPER: "Some Needed Tractor Research" By R. W. Trullinger, specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture. |
| 11:50 A. M. | Discussion |
| 12:30 P. M. | Special Tractor Luncheon and Get-Together |
| 2:00 P. M. | PAPER: "The Power Take-Off for Tractors" By F. N. G. Kranich, manager, tractor and implement bearings department, Timken Roller Bearing Company |
| 2:30 P. M. | Discussion |
| 3:00 P. M. | PAPER: "Tractor Belt Speeds" By L. H. Letz, chief engineer, The Letz Mfg. Co. |
| 3:30 P. M. | Discussion |
| 4:00 P. M. | REPORT of Committee on Belting, By John Mainland, Advance-Rumely Co. |
| 7:30 P. M. | Motion pictures showing modern tractor production methods and agricultural applications of the tractor |

#### S. A. E. PROGRAM—APRIL 30

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| 10:10 A. M. | PAPER: "Influence of Tractor Engine Development on Automobile, Truck, and Gas Engine Design" By L. B. Sperry, International Harvester Co. |
| 11:10 A. M. | PAPER: "Recent Developments in Production Methods and Equipment" (Speaker not yet selected) |
| 12:30 P. M. | Tractor Luncheon and Get-Together |
| 1.30 P. M. | PAPER: "Needed Research on Tractor Engines" By H. L. Horning, president, Waukesha Motor Co. |
| 2:40 P. M. | PAPER: "The Calculation and Design of Coil Springs" By E. W. Stewart, engineer, Wm. D. Gibson Spring Co. |
| 3:40 P. M. | PAPER: "Farm Mobile Power Equipment" (Not certain) |

## Temple Bill Becomes Law

IT will be of special interest to agricultural engineers to learn that the Temple Topographic Mapping Bill, which has been before Congress for several years, and which passed the House of Representatives some time ago, was finally passed by the Senate on February 19.

After the Bill was passed by the Senate and sent to the President it was submitted to the Director of the Budget, who fortunately made a favorable report on it and the President signed the measure on February 27, so that the Temple Bill has now become a law, undoubtedly due in a large degree to the interest which the Society and its members manifested in it and the efforts made to secure its passage.

As has been previously stated in this journal, the Temple Bill provides for the completion of the topographic map of the United States in a period of twenty years, continuing the U. S. Geological Survey's quadrangle sheets. A significant thing in connection with the Temple Bill is the fact that the United States is the only great country without an adequate map on which to plot our progress or the Nation's defense; it is, therefore, cause for a great deal of gratification to know that the Temple Bill has finally been enacted into law and that its objectives will now be carried out. It is an achievement by engineers for which they deserve a great deal of credit by the nation at large.

## Rural Electrification Abroad

THE electrical division of the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce during the past three months has issued several special circulars on the status of rural electrical development in foreign countries. These circulars are compiled from information on the subject secured through foreign attaches of the Department of Commerce. The circulars thus far issued cover rural electrification development in the following countries: Sweden, the Netherlands, Great Britain, Germany, Finland, Denmark, New Zealand, Italy and France.

## Necrology

### Edward W. Ahrendt

The Secretary's office has only just recently been advised of the passing away on November 7, 1924, of Edward W. Ahrendt, in charge of the experimental department of the International Harvester Company's plant at Neuss, France.

Mr. Ahrendt was born June 16, 1888, and after graduating from high school received some technical education at one of the Chicago polytechnic schools. He entered the employ of the International Harvester Company in June 1908 as junior draftsman at the Deering Works. He continued in that capacity until 1918, when he enlisted in the engineer corps of the army and was assigned to duty at Peoria, Illinois, in connection with the building of Holt tractors and tanks for the government. He showed marked ability and was recommended for a lieutenancy at the close of the war.

On his return to the Deering Works he was appointed designer of mowers and rakes, in which position he remained until September 1920, when he was sent to Neuss, France, to head the experimental department of his company there, which position he held until a few months previous to his passing.

## New A. S. A. E. Members

**Frank Adams**, professor of irrigation investigations and practice, University Farm, Davis, California.

**Herman F. Bahmeier**, ranch superintendent, Cantil, Kern County, California.

**Archibald Douglas Bell**, illuminating engineer, Edison Lamp Works of General Electric Company, Harrison, New Jersey.

**G. Santos y Ciocon**, department of agricultural engineering investigations, Bureau of Agriculture, Manila, Philippine Islands.

**William Burd Condit**, superintendent, E. W. Ross Company, Springfield, Ohio.

**LeRoy Collier Hart**, engineer and designer, Monroe, Georgia.

**Martin J. Lefler**, foreman in foundry, Union Malleable Iron Company, East Moline, Illinois.

**Nels Conrad Magnusan**, hydrographer, Texas Board of Water Engineers, Austin, Texas.

**A. Mollayan**, sales engineer, United Machines, Tire & Rubber Works, New York City.

**L. A. Paradise**, superintendent of experiments, John Deere Harvester Works, East Moline, Illinois.

TRANSFER OF GRADE

**John Thomas McAlister**, department of agricultural engineering, Clemson College, South Carolina. (From Associate Member to Member.)

**William H. Tague**, teacher, Marion Township High School, Marion, Illinois. (Student to Junior Member.)

## Applicants for Membership

The following is a list of applicants for membership received since the publication of the February issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for the consideration of the Council prior to election.

**Frank R. Brownlee**, thresher engineer and service manager, Minneapolis Steel & Machinery Company Minneapolis, Minnesota.

**Arthur W. Farrall**, assistant in dairy industry, University of California, Davis, California.

**Millard A. Klein**, consulting agriculturist, 517 First National Bank Building, Stockton, California.

**J. B. Trotman**, manager, commercial pump sales, The Goulds Manufacturing Company, Seneca Falls, New York.

**Floyd S. Wheeler**, general engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania.

TRANSFER OF GRADE

**Wendell P. Miller**, consulting agricultural engineer, 247 East Broad Street, Columbus, Ohio. (From Junior Member to Member.)

**John Laroy Saunders**, junior engineer, U. S. Geological Survey, Water Resources Branch, Austin, Texas. (From Student Member to Associate Member.)

## A. S. A. E. Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Nonmembers as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

### Men Available

AGRICULTURAL ENGINEER, 1923 graduate of Kansas State Agricultural College in agricultural engineering, desires to make a change. Work along engineering lines is preferred. Address M. S. Cook, 5406 Ferdinand Street, Chicago, Illinois. MA-121.

AGRICULTURAL ENGINEER with experience on large farms with all kinds of machinery and equipment wants position with manufacturer of farm equipment. MA-122.

AGRICULTURAL ENGINEER wants position with contractors doing work in farmstead planning and building. MA-123.

AGRICULTURAL ENGINEER open for position as sales engineer, salesman, advertising writer, or agricultural propagandist. Past experience with large agricultural firms. MA-124.